dissecting microscope at 20X was used to examine 50 pupae. Conformation of sex in relation to morphology was determined by dissection of the pupa for testes and ovaries.

Reliable methods to sex *C. hospes* pupae should be useful in research on the behavior and biology of this important pest species.

Acknowledgements. The assistance of Kelly Jones and Sharon Grugel in rearing *C. hospes* in the laboratory is acknowledged.

John F. Barker, United States Department of Agriculture, Metabolism and Radiation Research Laboratory, P.O.B. 5674, Fargo, ND 58105

Laboratory Rearing of *Sandia xami xami* (Lycaenidae, Eumaeini).

The population dynamics of *Sandia xami* in a small volcanic area near Mexico City has been studied since 1984. The high numbers of eggs required to perform life-table experiments lead us to attemp the rearing of *S. xami* in laboratory conditions.

S. xami flies from central México to the southern part of Texas and Arizona (Scott, J.A. 1986. *The butterflies of North America.* Stanford University press. Stanford, California. 583 pp.). In the Valley of Mexico *S. xami* can be found all year with peaks of abundance in August-October, January-March and, perhaps, April and May (Soberón, J., C. Cordero, B. Benrey, P. Parlange, C. Garcia-Saez and G. Berges. 1988. *Ecol. Entom. 13(1)*: 71-76.). *S. xami* feeds on several Crassulaceae species (Ziegler, J.B. and T. Escalante. 1964. *Jour. Lep. Soc. 18*: 85-89) but in the ecological reserve on the National University of Mexico Campus at Mexico City, the main food plant is *Echeveria gibbiflora.* The larvae eats the leaves, flowers and stem of the plant. *S. xami* may be regarded as a leaf-miner on the exceptionally thick leaves of *Echeveria.* The life cycle was partially described by Ziegler and Escalante (*op. cit.*). The territorial behavior of *S. xami* has been described by Cordero (1986. Defensa territorial en la mariposa *Sandia xami.* B. Sc. Thesis. Fac. de Ciencias. UNAM. 75 pp.) and Cordero and Soberón (submitted) and their oviposition patterns by Soberón *et al* (*op. cit.*).

Early Stages

To obtain the eggs in the laboratory, a fertilized female is placed in a cage (fig. 1) built according to Munger, F. and T.T. Harris (1970. *Jour. Res. Lep. 8*: 169-176.). A 100 watts tungsten lamp is placed over the insectary a providing a 8:16 LD. One or two pots with *Echeveria* are placed inside the insectary. The females lay most eggs on the surface of the plant, although it is not uncommon to find eggs on the pot. A single female can produce up to 200 eggs in a three week period (fig. 2). Peak egg-laying takes place in the first week.

Every morning eggs are removed using a fine camel hair brush slightly dampened with tap water. The eggs are then placed in square (1.5 cm side) cuts of *Echeveria* leaves over a filter paper and inside plastic Petri dishes.

Larvae that have emerged from eggs are fed with squares of *Echeveria* which are replaced as required. The humidity inside the Petri dishes is kept high by a drop of water every three days. The Petri dishes are kept at room temperature. A single, medium-sized leaf (10 cm long) provides food for one larvae to mature.

Larvae are handled with fine camel hair brushes during the first two instars.

Later instars can be manipulated with coarse brushes or entomological forceps.

When larvae are ready to pupate, they stay still at the edge of the Petri dish and remain in this state for three to four days.

When adults are ready to emerge (16 to 20 days from beginning of pupation depending on temperature of the year, $\bar{x} = 16.9$ days, S.E. = 1.2), the pupae are placed in a closed plastic box with enough space for the spreading of the wings to take place.

Mortality is usually low at every instar, with the exception of the first. New larvae can be easily damaged by handling. A sumary of several laboratory life tables is presented in fig. 3.

The adults are maintained in the insectaries on a diet of 10% sucrose on water with a few drops of commercially available hydrolyzed vegetable proteins ("Jugo Maggi", trade mark, similar to soy sauce). Small cubes of plastic foam moisted with this solution are placed at the end of 10 cm wood sticks attached vertically to a base of clay. The adults must be placed by hand upon the foam cubes. This can be easily performed by gently persuading them to attach themselves to one finger and then placing the butterfly on the foam. At room temperature in Mexico City (around 20°C) adults can survive for as long as 40 days.

Mating

Inducing butterflies to copulate in laboratory conditions is seldom an easy task. Hand-pairing has been successful for large butterflies (Clarke, C.A. and P.M. Sheppard. 1956. *Jour. Lep. Soc. 10*: 47-53.), but the Lycaenids are more difficult to hand-pair because the genital armature is more deeply hidden than in other families (Clarke and Sheppard, *op. cit.*). We tried the hand-pairing methods, but none was successful. We have developed two techniques, described as follows.

1) We placed pairs of laboratory-raised butterflies in portable cages made of green net cloth and wire (fig. 4). These are then hung outside the laboratory, in direct sunlight. Matings occur within the hour. At first we used both wild-caught and laboratory specimens, but wild males always refused to mate. Seventeen attempts, during cloudless weather, using laboratory reared butterflies yielded 15 successful matings. The two failures were apparently due to female refusal because of unknown causes. This method works quite well, but it relies on availability of sunlight and, perhaps, on a good ventilation of the cages (R. Mattoni, personal communication).

2) It is also possible to obtain matings with males in the wild. Many territories are located in conspicuous places that are usually occupied by a male (Cordero, *op. cit.*; Cordero and Sberón, *op. cit.*). A laboratory female, one or two days old, is placed in a small card box with the lid attached to a string. The box is fixed to the end of a 1.5 m wood pole. The box is then placed as close as possible to the perching male and the lid opened by pulling the string. When the female emerges, a mating flight usually ensues, with a high probability of a successful pairing. In our area the vegetation includes *Buddleia* trees, which can be 4 or 5 meters tall. If the mating takes place on a tree, recapturing the couple may be impossible, but when the mating occurs in an accessible place, recapture after a period of 1 hour has always yielded a fertilized female. We have released 16 females and recovered 7 fertilized females.

Although this method requires the localization of an occupied territory and is less reliable than the first, it can be used to mantain heterozygocity.

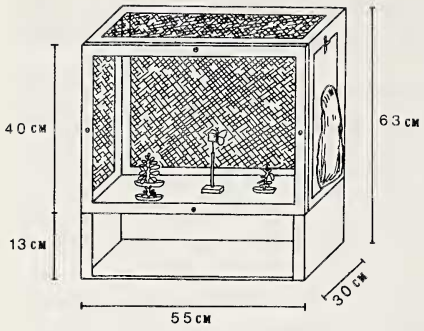

Fig. 1 Insectary for the maintenance and oviposition of adult *Sandia xami*, built according to Munger and Harris (1970).

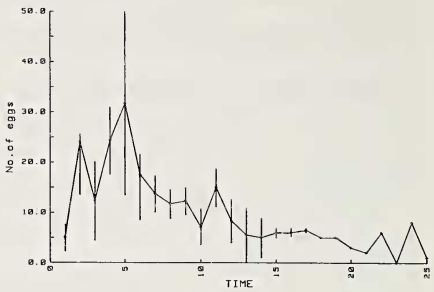

Fig. 2 Mean oviposition per day for female *Sandia xami*, in laboratory conditions with 8:16 LD light. The eggs were removed every morning. Mean ± standard error. N = 7.

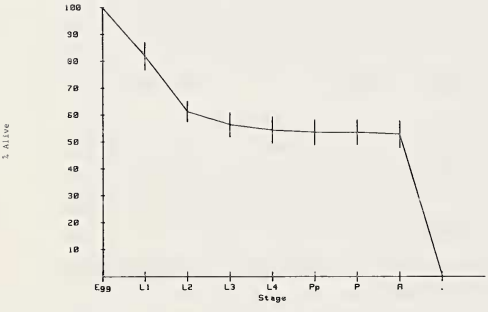

Fig. 3 Mean survivorship curve of seven laboratory life tables. Bars are standard errors. In parenthesis mean and standard error of duration of stage in days. Eggs (6.89 ± 0.07); L1 = first instar (5.36 ± 0.06); L2 = second instar (4.71 ± 0.07); L3 = third instar (5.40 ± 0.10); L4 = fourth instar (6.72 ± 0.13); Pp = prepupal larvae (3.70 ± 0.04); P = pupa (18.39 ± 0.25); A = adult (31.34 ± 1.18).

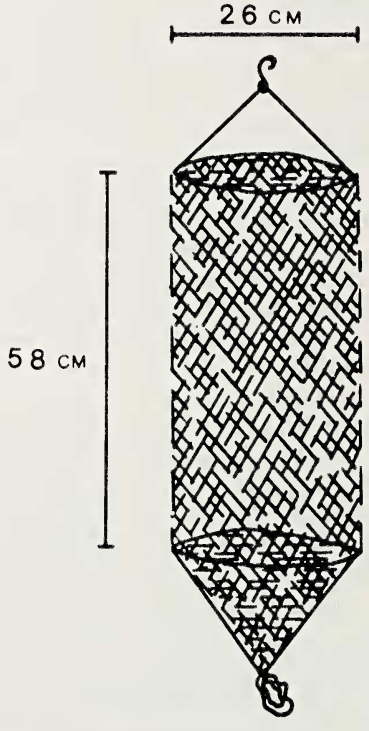

Fig. 4 Mating portable cage.

Acknowledgements. We are thankful to Dr. Jorge Llorente, of the Faculty of Sciences of the UNAM, and Dr. Kurt Johnson, of the American Museum of Natural History for their suggestion of the first method for inducing matings and Dr. Mattoni for his comments on this manuscript. Paulina Parlange, Betty Benrey, Gerardo Berges and Carlos Cordero were very helpful at different stages of this work.

Gabriela Jiménez C. & Jorge Soberón M., Centro de Ecologia, UNAM, Apdo. Postal 70–275, Ciudad Universitaria, México 04510 D.F., MEXICO

THE END OF NATURE: 1989. Bill McKibben. Random House, N.Y. 230 pp. $19.95

Armageddon 1: Nature O.

The End of Nature, a landmark book for this century on the philosophy of the relationship of man to the environment, was not written by a scientist, but by a reporter. To the academic clique this lack of credentials may be looked upon with suspicion, but the clarity of thinking, mastery of fact, cool objectivity and charm of writing are both very impressive and very moving.

I don't believe any of our members, who are almost universally in regular touch with nature, will fail to grasp or disagree with the central thesis of the book: nature has come to an end. Nature here is that idea describing the set of interactions among wild organisms that we think of as the planetary ecosystem. In the meantime we all go blithely consuming, travelling, and making investment decisions like life as we know it will all go on forever. In the meantime the almost certainly entrained global warming trend is signalling continuing disintegration of the environment with a foreseeable end to the lifestyles we have grown to accept. Deductions from the impact of human resource depletion is nothing new, of course, but what McKibben shows is that the wild nature in which we evolved is no more. We now live in a man-made world.

The destruction of nature is not only irreversible, but will in all likelihood be compounded by the "fixes" technology has and will generate. This pessimistic conclusion will probably not be accepted in the popular weltanschaung. The laws of nature, as thermodynamics and relativity, have not been repealed, many forests are still green, there are masses of moth species in some tropical places and there are a few aborigines around. But this is a managed home. My job with "restoration and management" of endangered species at the El Segundo sand dunes focuses on the absurdity. This tad of nature only now exists at our pleasure. The catena is gone.

You cannot fail to read this book. It is not strident or hysterical. There is no preaching or demands for change in life style. It is reflective, disturbing and very topical.

R. H. T. Mattoni, 9620 Heather Road, Beverly Hills, CA 90210, USA